

Abstract

In the administration, planning, design, and maintenance of road systems, transportation professionals often need to choose between alternatives, justify decisions, evaluate tradeoffs, determine how much to spend, set priorities, assess how well the network meets traveler needs, and communicate the basis for their actions to others. A variety of technical guidelines, tools, and methods have been developed to help with these activities. Such work aids include design criteria guidelines, design exception analysis methods, needs studies, revenue allocation schemes, regional planning guides, designation of minimum standards, sufficiency ratings, management systems, point based systems to determine eligibility for paving, functional classification, and bridge ratings.

While such tools play valuable roles, they also manifest a number of deficiencies and are poorly integrated. Design guides tell what solutions MAY be used, they aren't oriented towards helping find which one SHOULD be used. Design exception methods help justify deviation from design guide requirements but omit consideration of important factors. Resource distribution is too often based on dividing up what's available rather than helping determine how much should be spent. Point systems serve well as procedural tools but are employed primarily to justify decisions that have already been made. In addition, the tools aren't very scalable: a system level method of analysis seldom works at the project level and vice versa.

In conjunction with the issues cited above, the operation and financing of the road and highway system is often the subject of criticisms that raise fundamental questions: What is the best way to determine how much money should be spent on a city or a county's road network? Is the size and quality of the rural road system appropriate? Is too much or too little money spent on road work? What parts of the system should be upgraded and in what sequence? Do truckers receive a hidden subsidy from other motorists? Do transportation professions evaluate road situations from too narrow of a perspective?

In considering the issues and questions the author concluded that it would be of value if one could identify and develop a new method that would overcome the shortcomings of existing methods, be scalable, be capable of being understood by the general public, and utilize a broad viewpoint. After trying out a number of concepts, it appeared that a good approach would be to view the road network as a sub-component of a much larger system that also includes vehicles, people, goods-in-transit, and all the ancillary items needed to make the system function. Highway investment decisions could then be made on the basis of how they affect the total cost of operating the total system.

A concept, named the "Total Cost of Transportation" method, was then developed and tested. The concept rests on four key principles: 1) that roads are but one sub-system of a much larger 'Road Based Transportation System', 2) that the size and activity level of the overall system are determined by market forces, 3) that the sum of everything expended, consumed, given up, or permanently reserved in building the system and generating the activity that results from the market forces represents the total cost of transportation, and 4) that the economic purpose of making road improvements is to minimize that total cost.

To test the practical value of the theory, a special database and spreadsheet model of Iowa's county road network was developed. This involved creating a physical model to represent the size, characteristics, activity levels, and the rates at which the activities take place, developing a companion economic cost model, then using the two in tandem to explore a variety of issues.

Ultimately, the theory and model proved capable of being used in full system, partial system, single segment, project, and general design guide levels of analysis. The method appeared to be capable of remedying many of the existing work method defects and to answer society's transportation questions from a new perspective.